PANCAKE-LIKE SHIELDS IN THE PATHFINDER LANDING SITE, MARS. R. C. Anderson and T. J. Parker, Jet Propulsion Laboratory, Pasadena CA, 91009, randerson@jpl.nasa.gov.

Introduction

Numerous pancake-like shields can be identified within the plains of the Ares Valles region of Mars. This area has been designated as the landing site for the Mars Pathfinder spacecraft on July 4, 1997. Pancake-like shields are flat-topped circular structures a few kilometers in diameter characterized by very low topographic relief with respect to the surrounding plains [1,2]. From the Viking images, they may have a variety of different albedos making them hard to delineate from the surrounding plains. These shield structures lack obvious central vents and are confined exclusively to the plains and have not been identified on the flanks or tails of the streamlined islands.

Models

The pancake-like shields have been interpreted as volcanic structures [1,2]. These structures were described as low, broad shields containing long linear dike-like ridges, cratered and uncratered cones, buttes, and knobs resembling volcanic necks [1,2]. Greeley et al, [1] compared these features to Snake River Plains cinder cones.

Parker and Rice [7] suggested their "pseudovolcanic" mechanism for formation. In this model, the structures were derived from differential loading in the rapidly-emplaced wet sediments from Ares and Tiu Valles. Several sedimentary structures could result from this process such as sand volcanoes, mud loccoliths, and clastic dikes [3].

Methodology

Stereo images (Figure 1) were processed and profiles obtained from twelve pancake-like shields using photoclinometry (Figure 2). Photoclinometry measurements were obtained using high-resolution images that also provided stereo pairs with large parallax angles [4]. Photoclinometry provides the highest topographic measurement precision currently available but contains a number of potential sources of error [5].

Observations

Despite their large numbers, the shields display no evidence of channel scour or streamlining [6]. This is in contrast from the pre-flood craters observed in the region which display extensive scour on their upstream sides and debris tail deposits on their lee sides. This suggests that the formation of the shields occurred after the major regional flood event. Additional evidence to support this hypothesis is: 1) etched terrain (west of landing ellipse) has developed surrounding the shields and has eroded the adjacent plains. The erosion left shields standing high on the sides which border the etched surface. On the other sides, the shields appear flush with the surrounding plains. 2) at least one of the smaller impact crater ejecta blankets appears to have locally armored the surrounding plains, protecting them from the etching process. Both lines of evidence support the inference that the etching occurred after flooding, rather than as a result of fluvial plucking during the flood.

Understanding the timing between the formation of the shields and the flooding is critical. If the shields formed prior to the regional flooding, the etching process must have been capable of removing meters of material without altering the surface morphology of the surrounding plains. Eolian deflation of fine sediments is possible, but this mechanism would require that the particle size be sand-size or finer to a depth of 10 to 20 meters in the areas where pits have been identified. Sublimation of ice might be another mechanism. In the near subsurface area after the flooding, the sublimation of a massive ice sheet under a thin veneer of insulating material could produce etch pits. This overlying material might be deposits from a late stage flooding event, or even may be post-flood eolian sediments.

References

[1] Greeley et al., (1977), JGR, 82, 4093-4109. [2] C. A. Hodges & H. J. Moore, (1994), USGS Prof. Paper, 1534, 194p. [3] J.R.L. (1985) Allen in Physical Sedimentology, 272p. [4] T.J. Parker, (1995), LPI Tech. Paper 95-01, 23-24. [5] D.G. Jankowski and S.W. Squyres (1991), JGR, Planets 96, E4, 907-922. [6] T.J. Parker & J.W. Rice Jr. (1997), submitted, in review JGR.

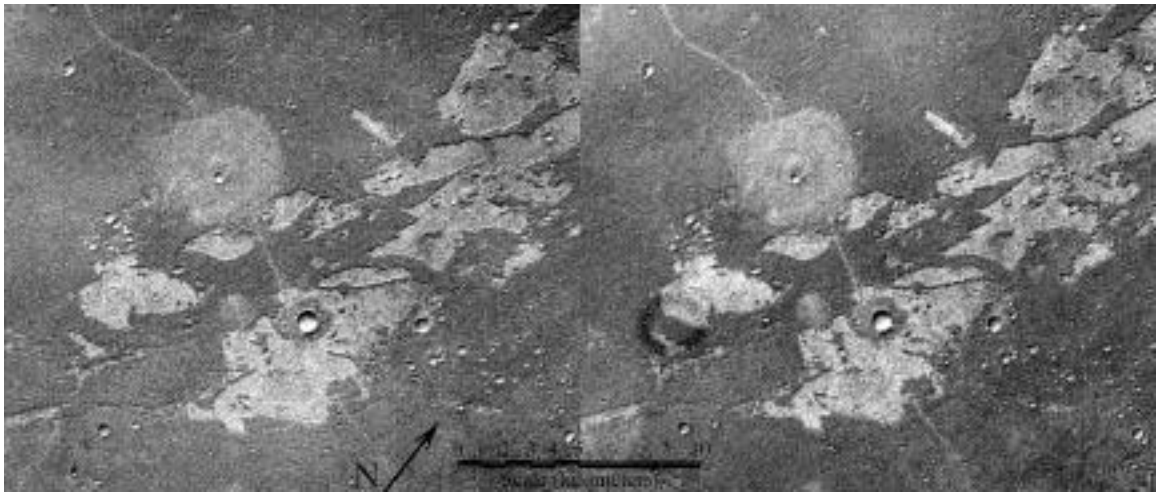

Figure 1 Stereo image pair of bright shields and dikes against dark plains (Viking Orbiter frames 004A19 (left) and 004A79 (right).

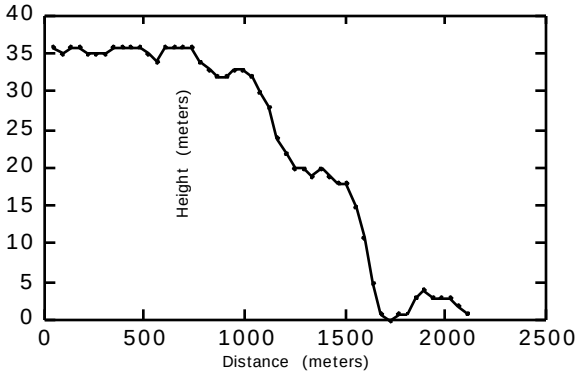

Figure 2 Symmetric photoclinometric profile of pancake-like shield in western section of the Mars Pathfinder landing ellipse. Shield is surrounded by etched terrain with approximately 20 meters of relief (Scrap at right).